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BULLETIN No. 7

The MAKING and DRIVING of CORRUGATED CONCRETE PILES

Association of American Portland Cement
Manufacturers, Philadelphia

The Making and Driving of Corrugated Concrete Piles

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By

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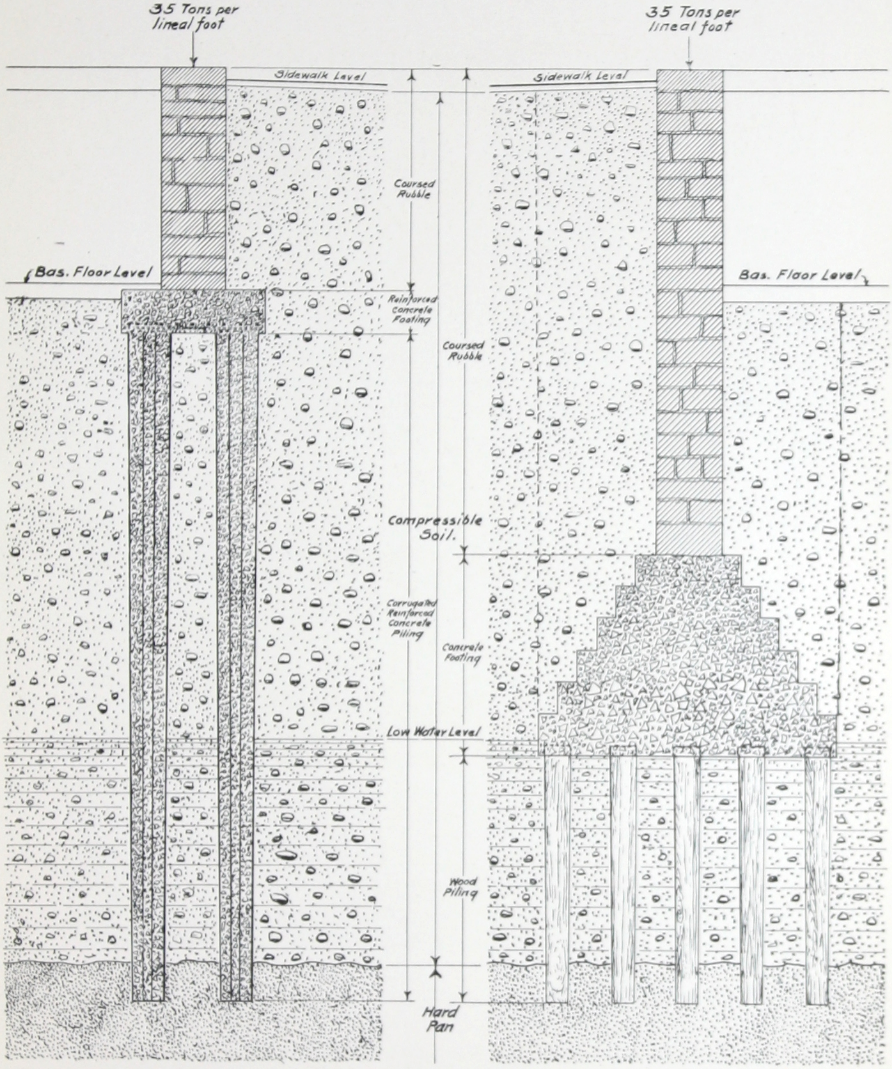
out the construction and method of sinking of the Corrugated Pile, was the building for the Simmons Hardware Company, of St. Louis, at Sioux City, Iowa.

The conditions on this lot were not unlike those shown in Figure II.



Corrugated Reinforced Concrete Piling

Wood Piling

FOUNDATION

The low-water level was located some twelve feet below the cellar bottom, and it was necessary either to sink very deep foundations, with their attending great cost, or else to use piling. The deep foundations being too costly, the next choice was between concrete piles and wooden piles. Two or three times as many wooden piles as concrete piles would have to be used, owing to the inferior supporting power of the wooden piles. Again the wooden piles would have to be cut off at a grade as low or lower than the low-water level, while the concrete piles could extend up to the reinforced concrete footings, which could be placed directly below the basement floor level. With the wooden piles there would also be a large expense for excavation, and sawing off of the piles, sheet piling, pumping, extra deep foundations, and back filling. With the concrete piles it was possible not only to save this cost, but also to save so much time that the rent available would come near to covering the cost of the piles.

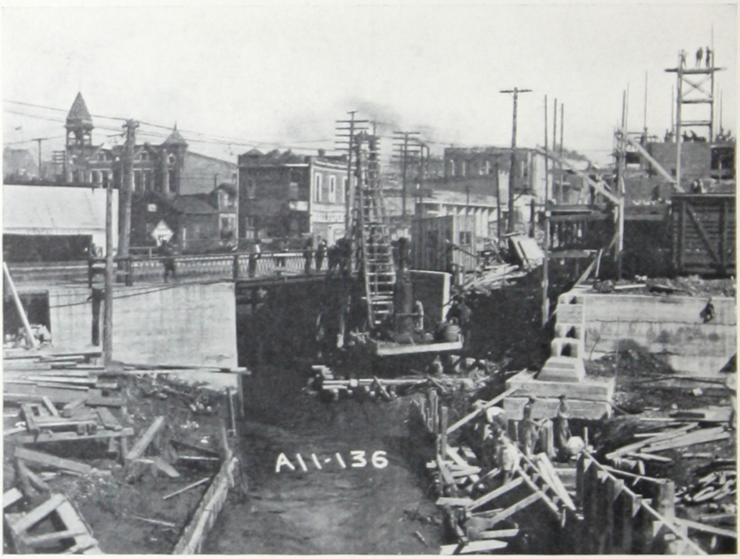


Figure III.

Figure III shows the footing, the bottom of which is about level with the exterior surrounding ground. A number of piles can be seen in the concrete forms of the retaining walls.

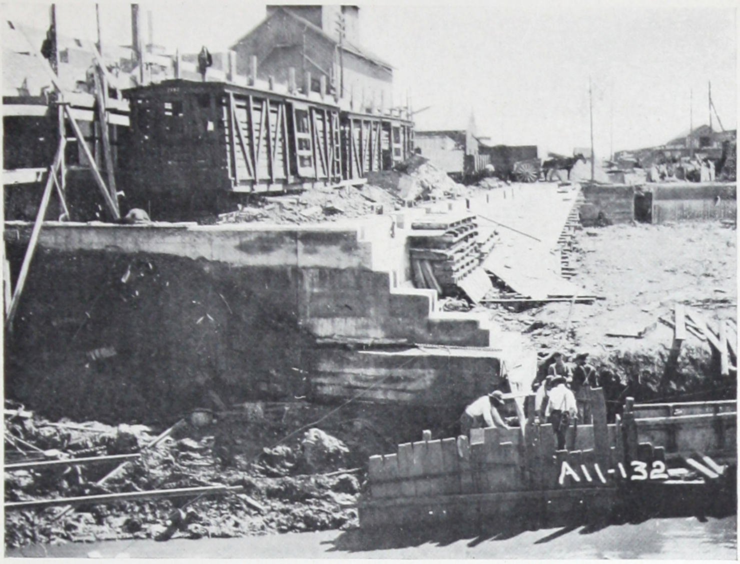


Figure IV.

Figure IV is another view of the foundation wall, the footing of which is level with the ground, and several feet higher than the low water in the creek.

Now for the pile itself.

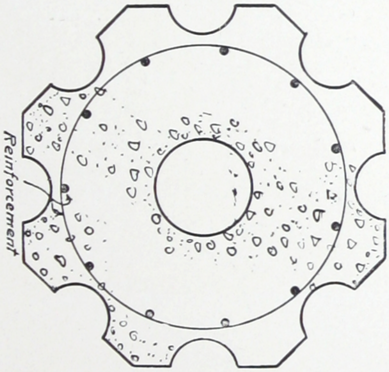


Figure V.

Figure V shows a typical cross-section of the pile as finally adopted on the Simmons Hardware Company's building, and also on the shoe factory for Mr. John J. Latteman in Brooklyn. This particular arrangement of the corrugations was adopted for reasons of economy in the construction of the forms. At first glance it looks like a circle, but in reality it was made as an octagon or a hexagon, with grooves that did not diminish at the small end of the pile, although the pile tapered from sixteen inches across at the larger end to eleven inches at the smaller, lower end. The reinforcement shown is Clinton Electrically welded Fabric, and the size is approximately ⅜-inch wires, 3 inches on centres longitudinally, with approximately ⅛-inch wires, 12 inches on centres around the pile. The hole in the centre is made 3½ inches in diameter at the top of the pile, and 2 inches at the bottom of the pile. This hole is made tapering for two reasons:

(a) So as to have a large quantity of concrete in the lower end of the pile.

(b) So that the tapering plug that is used to cast the hole in the pile can be easily withdrawn.

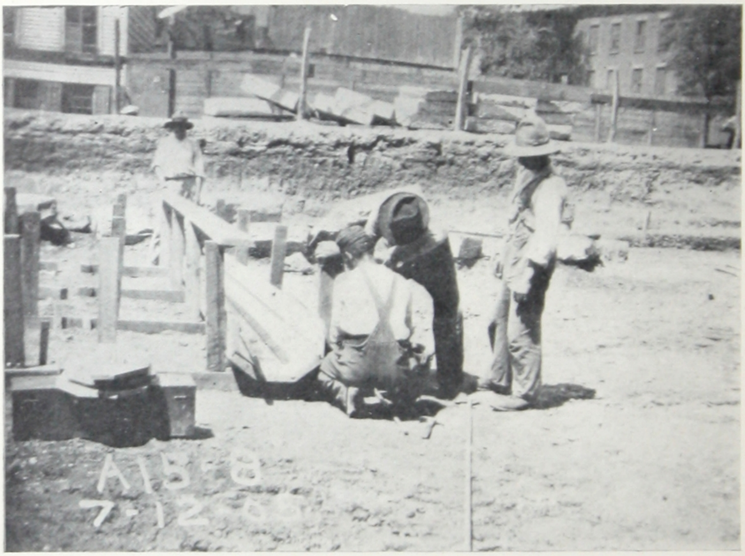


Figure VI

Figure VI shows method of constructing the forms

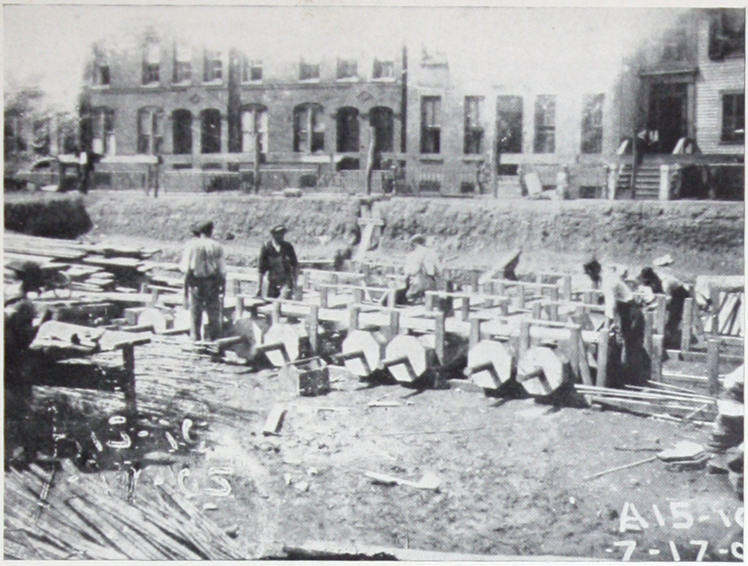


Figure VII.

Figure VII shows the round, tapering plug that, when withdrawn after the concrete had set, leaves the hole through which the jet passes the entire length of the pile.

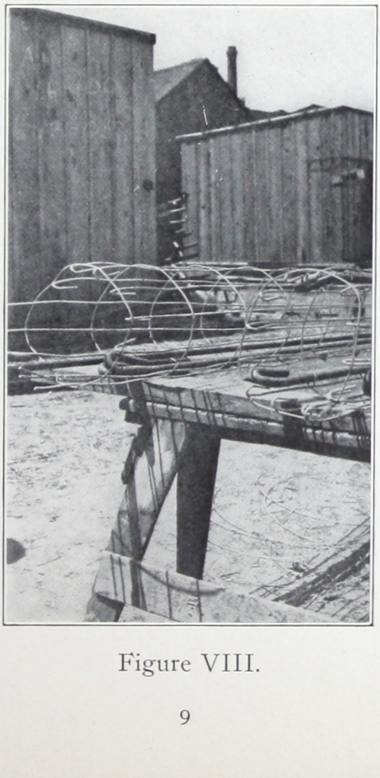


Figure VIII shows the reinforcement ready to be placed inside the form. Some of the first piles that were driven had, in addition to this reinforcement, some ¾-inch round rods, that were hooked to prevent slipping in the concrete. These rods were found to be unnecessary, and were later discontinued.

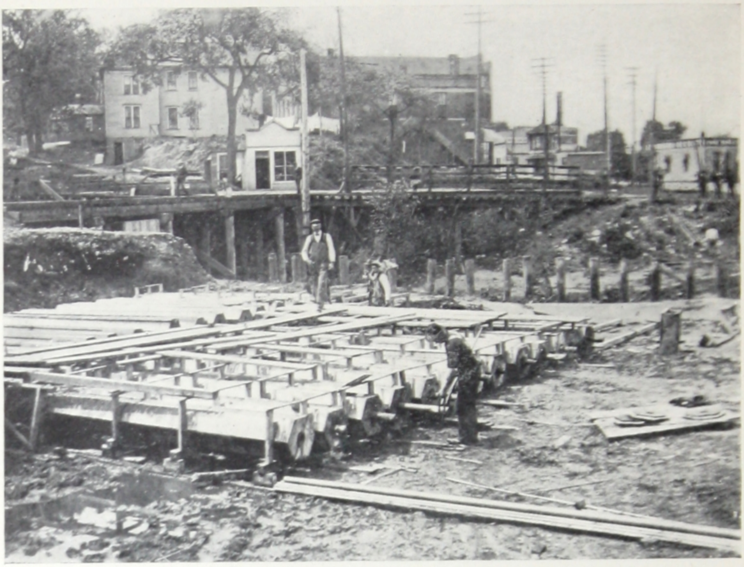


Figure IX.

Figure IX shows a laborer pulling the cores out of the set concrete. He is using for this work an ordinary chain pipe wrench.

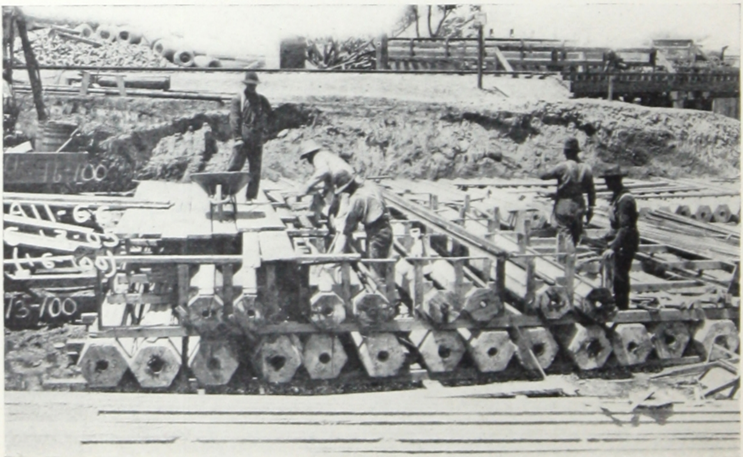


Figure X shows how the piles were cast in tiers to economize space in a city lot. The rolls of Clinton Wire Cloth can be seen in the background in the condition in which they are shipped to the job. Note the date on the end of the piles. This aids in keeping a record of their history. Note also that the sixth or top side of the hexagon form is missing. This is left off, so that the concrete can be properly tamped and thoroughly inspected at all times by the foreman and the inspector. One of the fine features of this pile is that there is no guesswork regarding its construction, or regarding the location of its reinforcement.

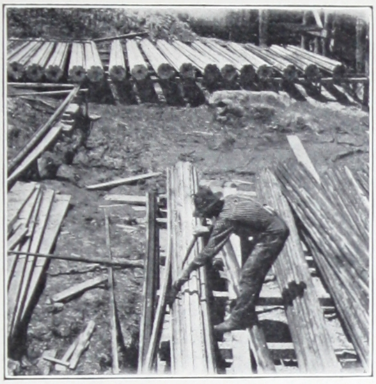


Figure XI.

Figure XI shows how the forms are stripped from the piles. It also shows the piping from the boilers to the jets, the mortar beds and the concrete mixers.

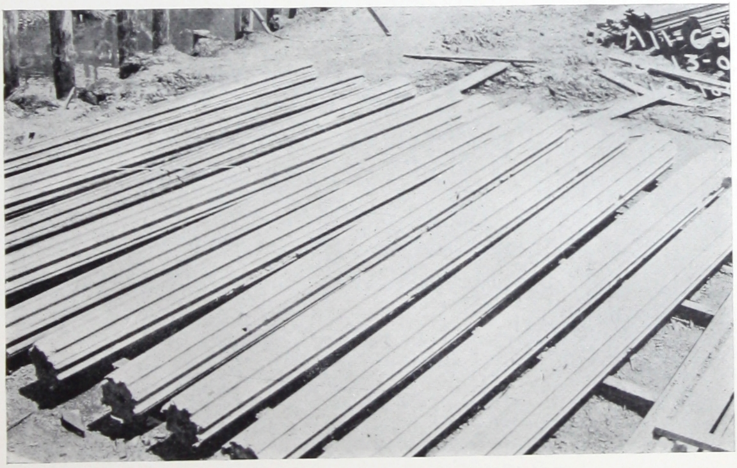


Figure XII shows the piles after the forms have been stripped off. It is a particularly good view of the corrugations, which serve the purpose of:

(a) Increasing the surface for skin friction.
(b) Outlets for the water from the jet.

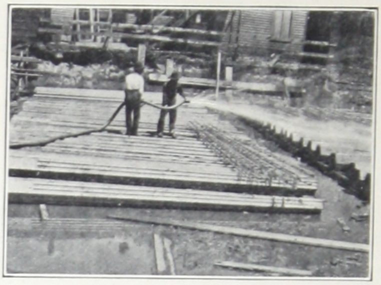


Figure XIII.

Figure XIII shows the piles being sprayed to secure the proper hardening of concrete.

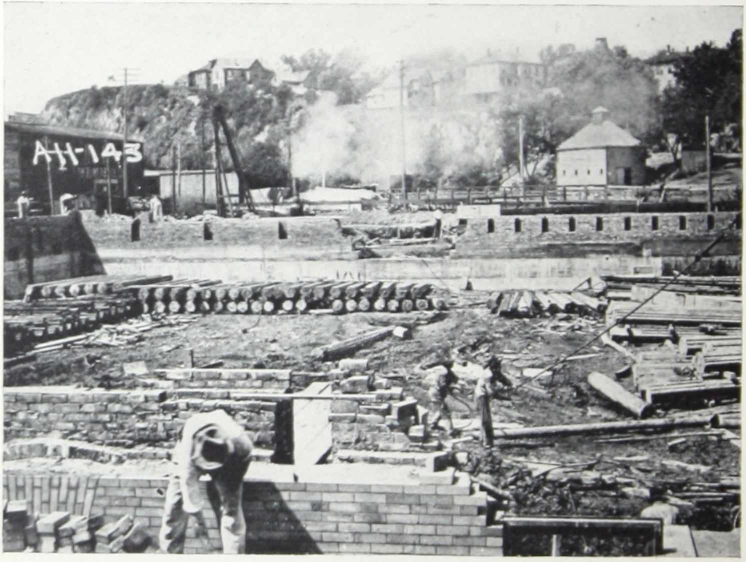


Figure XIV.

Figure XIV shows the pile driving and the exterior walls around the entire building proceeding simultaneously.

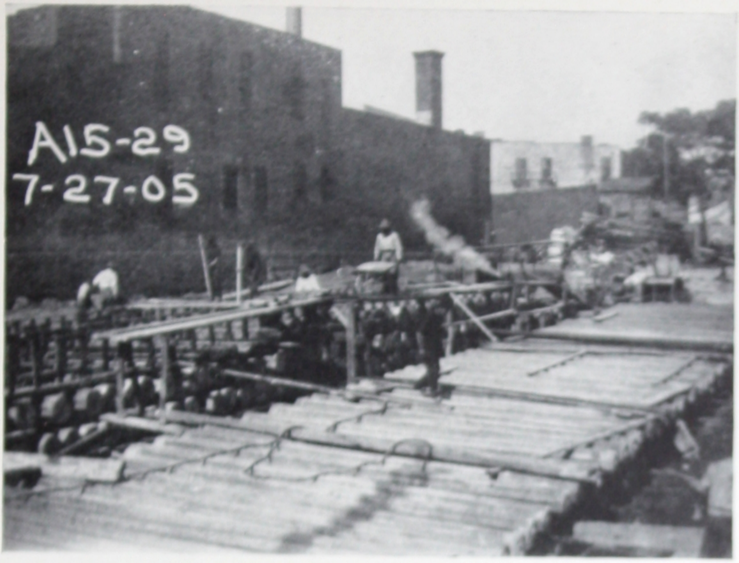


Figure XV.

Figures XV and XVI show the foundation for the new shoe factory at Brooklyn for Mr. John J. Latteman.

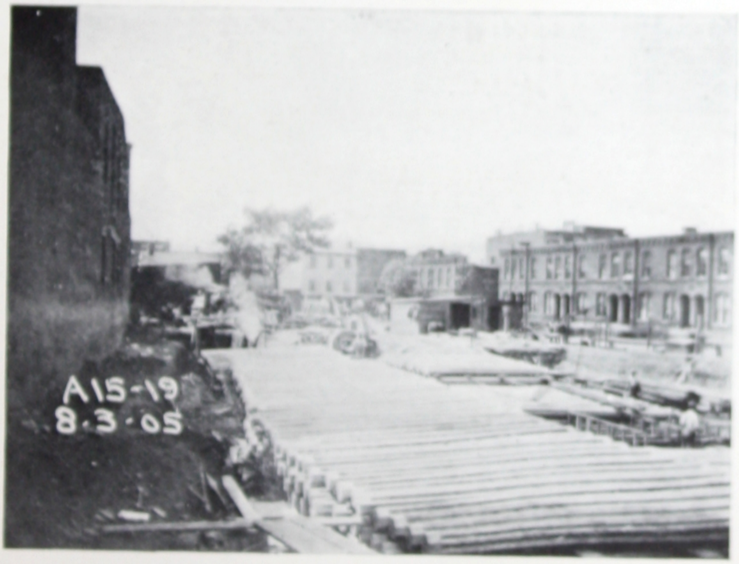


Figure XVI.

Turning now to the sinking of the piles, Figures XVII and XVIII which are good views of the Simmons Hardware Company's building, covering about 30,000 square feet of land, show the two types of pile drivers used. The pile driver in the foreground is mounted simply on rollers, while the pile driver in the distance is mounted on a swivel. It was determined that unless the piles were very close together, the pile driver that did not swivel was the more economical.

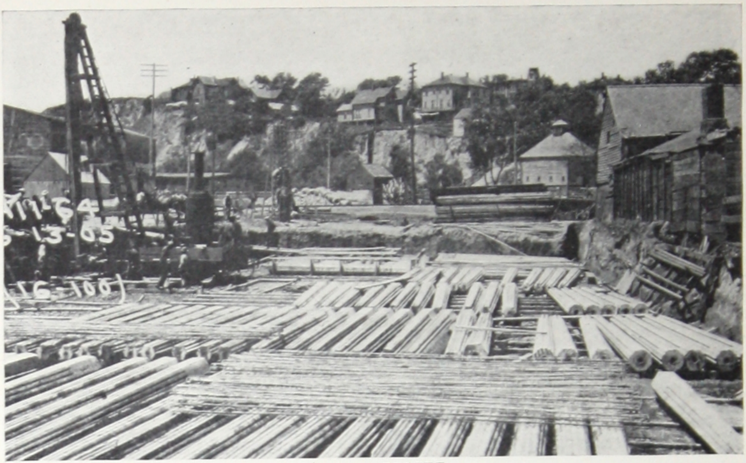


Figure XVII.

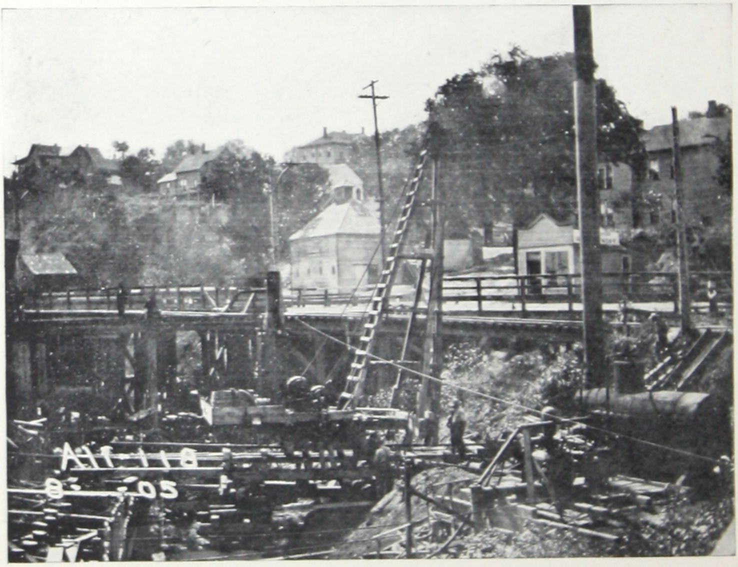


Figure XVIII shows the duplex boiler and pump that were used for the water pumping plant. The pump drew the water up from Perry Creek, and forced it for the various pile-drivers' jets, spray pipes and concrete mixers. In the background is the swivel pile-driver, driving the piles for the retaining walls of the creek.

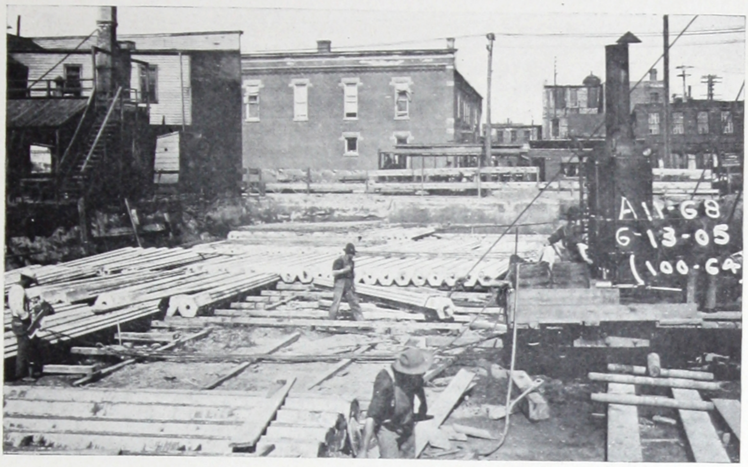


Figure XIX.

Figures XIX and XX show the pile being dragged by a rope to the pile-driver, just as a wooden pile would be handled. The pile-drivers used were not specially constructed, but were the ordinary pile-drivers for wooden piles.

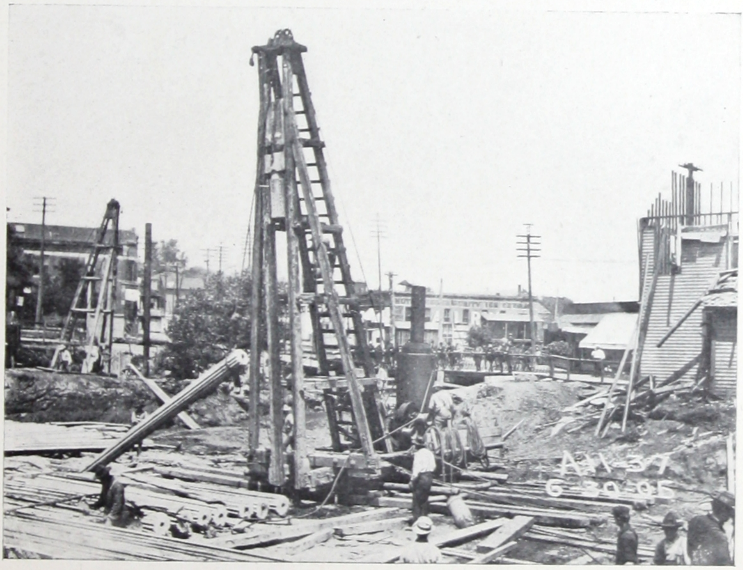


Figure XX.

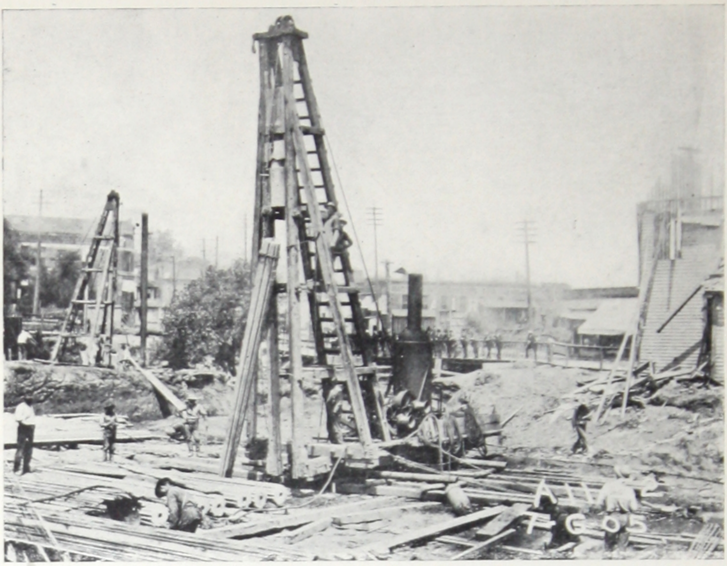


Figure XXI.

Figure XXI shows the pile being hoisted into place ready for driving.

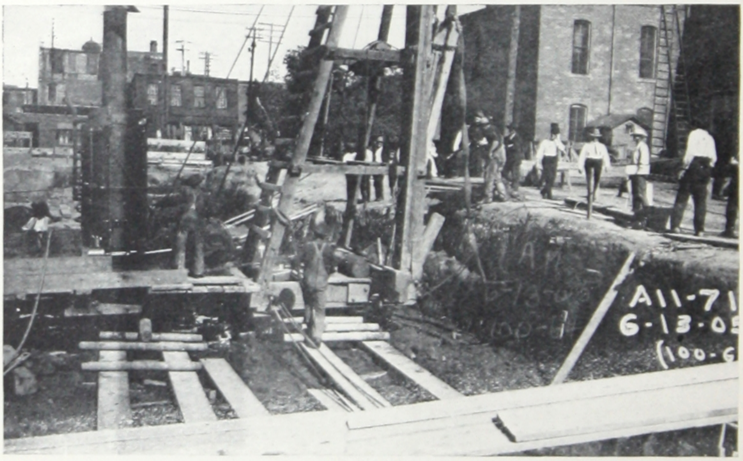


Figure XXII.

Figure XXII shows the bottom of the pile in place. Note the hose. The water pressure is not turned on.

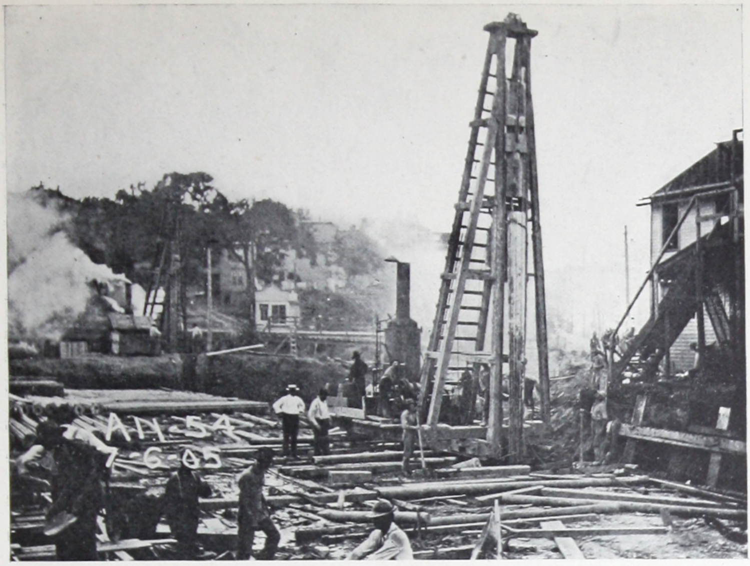
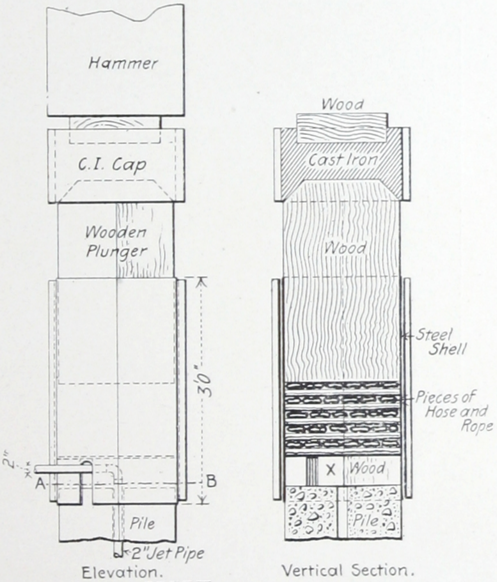


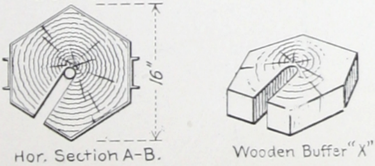
Figure XXIII.

Figure XXIII shows the pile in place. The cushion head will now be lowered over it.



Elevation.

Vertical Section.



Hor. Section A-B.

Wooden Buffer "X"

Figure XXIV shows the details of construction of the cushion cap. It was found that this cap would protect even the sharp edges of the top of the pile, provided the pile was made eight days before driving.

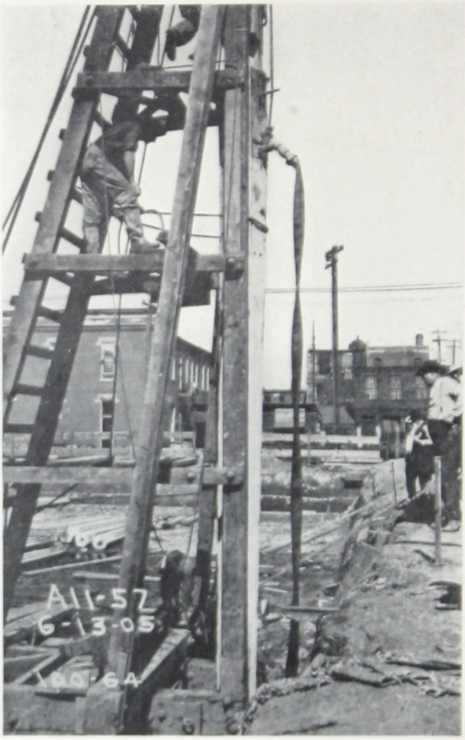


Figure XXV.

Figure XXV shows the jet as it is put down into the pile. The man with the rope guides the head of the pile to its exact position under the head of the cap. The cap is lowered around the top of the pile. It forms a cushion and also a guide to the head of the pile.

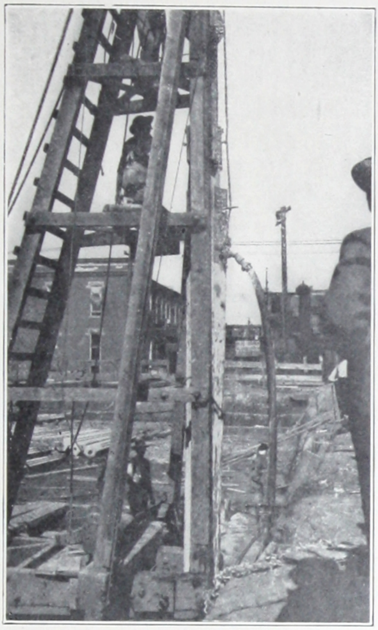


Figure XXVI.

Figure XXVI shows the water pressure on in full force. The jet extends through the entire length of the pile and protrudes three inches below the bottom of the pile. The tremendous pressure of the water is sufficient to dig a hole and carry the loosened sand, gravel and earth up the corrugations, which act as an exhaust to the jet. The weight of the hammer pushes the pile down into the hole. When the pile is nearly in place, the hammer and cushion cap are hoisted up, and the jet is removed, the cushion cap is again lowered over the head of the pile, and the hammer forces the pile to refusal. A large amount of alternate layers of old rope and rubber-lined canvas hose forms a cushion so perfect that the hammer cannot injure the pile in the least degree.

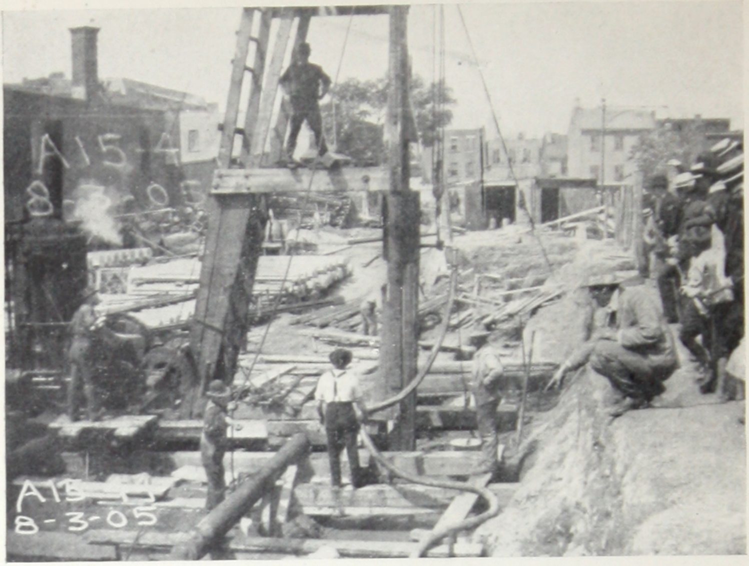


Figure XXVII.

Figure XXVII shows the manner in which the jet is handled by a tackle, with the hauling part led to a winch head of the engine.

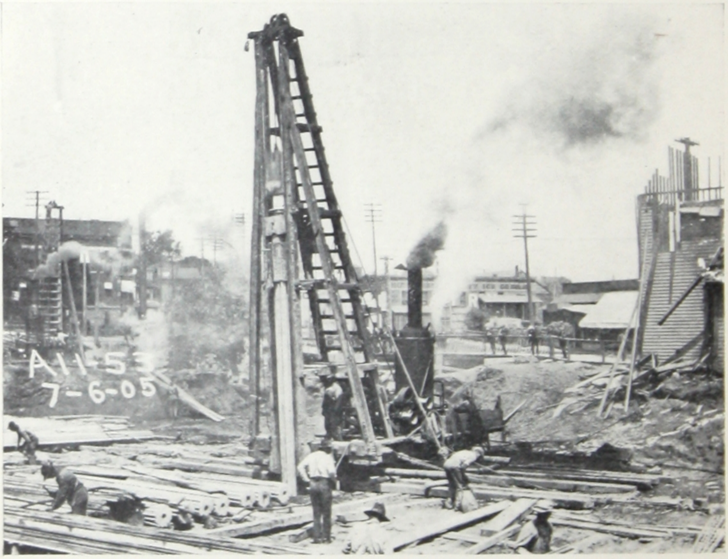


Figure XXVIII shows the pile partially driven. In some cases the piles, with the aid of the jet, were set down their entire length in less than two minutes from the time the jet was turned on. The excavated material spurted from each of the six corrugations to a distance of one to three feet above the surface of the ground.

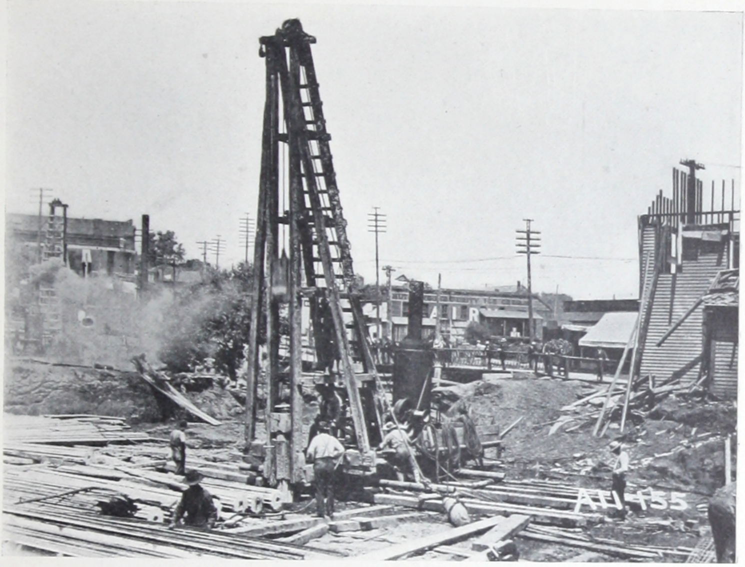


Figure XXIX.

Figure XXIX shows the hammer falling a long distance on to the cushion cap. In hard driving we have dropped a 2500-pound hammer falling 25 feet, 20 to 30 times, without the slightest injury to the head or any other part of the pile.

After the driving comes the testing.

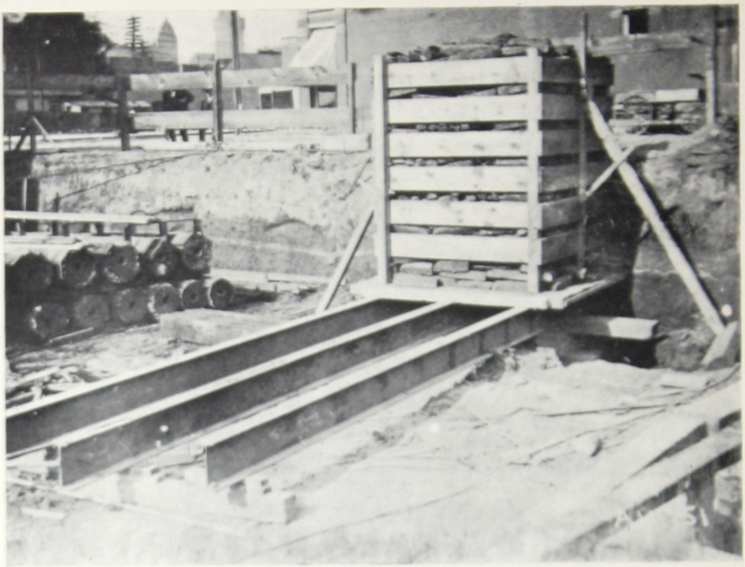


Figure XXX.

Figure XXX shows the method of balancing 45 tons of pig iron on the top of one pile.

Our experience has brought out the following facts:

All concrete piles are good, far better than any wooden pile.

Wooden piles are becoming scarcer and more expensive every day.

Wooden piles begin to deteriorate from the day they are driven, unless always wet and out of reach of boring animals.

Wooden piles are often destroyed by the marine borers known as teredo and limnoria

The following is a list of papers which have been printed by the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia; copies of which may be obtained by addressing as above:

Bulletin No. 1—"Concrete Building Blocks," by S. B. Newberry.

Bulletin No. 2—"The Possibilities of Concrete Construction from the Standpoint of Utility and Art," by Wm. L. Price.

Bulletin No. 3—"Sand for Mortar and Concrete," by Sanford E. Thompson.

Bulletin No. 4—"Notes on Cement Testing," by W. P. Taylor.

Bulletin No. 5—"Irregular Methods of Testing Cement," by H. A. Schaffer.

Bulletin No. 6—"Comment on the Advantages and Limitations of Reinforced Concrete," by Chas. S. Hill.

Bulletin No. 7—The Making and Driving of Corrugated Concrete Piles, by Frank B. Gilbreth.

Bulletin No. 8—"The Proportions of Cement Mixtures," by Spencer B. Newberry.

Bulletin No. 9—"Methods of Testing and Some Peculiarities of Cement," by W. A. Aiken.

Bulletin No. 10—"The Decoration of Concrete with Colored Clays," by Henry C. Mercer.

"Concrete Construction—Its Fireproof Qualities."

"Standard Methods of Testing and Specifications for Cement."